REMARKS

Claims 1, 5, 11-14, and 22 remain pending. Claims 1 and 12 are currently amended. Claims 2-4, 6-10, and 15-21 are canceled. No claims are added. The specification and some of the claims are amended to address informalities.

According to page 2 of the Office Action, claims 1, 3, and 14-16 stand rejected under 35 U.S.C. § 103(a) as obvious over Ahonen (U.S. Patent No. 5,216,330) in view of Hashimoto et al. (U.S. Patent No. 4,870,284), and further in view of England et al. (U.S. Patent No. 5,969,366). Although claim 12 is not listed on page *2*, it is mentioned two times on page *3*. Thus, it appears that claim 12 is also intended to be rejected. With respect to claims 3, 15, and 16, because those claims are now canceled, their rejections are moot.

Regarding claims 1, 12, and 14, applicants respectfully traverse their rejection for two reasons.

First, claims 1 and 12, as amended, describe a beam source and a neutral particle beam source, respectively, such that:

> ... each of the beam-emitting holes formed in the beam-emitting electrode on the downstream end has a length-to-diameter ratio of 2 or greater.

Claim 14 depends from claim 12, so claim 14 also describes a neutral particle beam source with this feature.

The Advisory Action mailed December 29, 2004 characterizes the claimed length-to-diameter ratio as merely "discovering the optimum or working ranges," and *In re Aller* is cited. Apparently, the provisions of MPEP § 2144.05 are invoked. This section of the MPEP discusses how patentability is determined with respect to the optimization within prior art conditions or through routine experimentation. Specifically, MPEP § 2144.05 provides:

> Generally, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955) (Claimed process which was performed at a temperature between 40°C and 80°C and an acid concentration between 25% and 70% was held to be prima facie obvious over a reference process which differed from the claims only in that the reference process was performed at a temperature of 100°C and an acid concentration of 10%.) ...

Although the claimed length-to-diameter ratio is not a "concentration" or a "temperature," the same legal principle with respect to optimization of a value is apparently invoked.

However, the above-quoted portion of the MPEP indicates that, if the claimed value is critical, the above legal principle does *not* apply. Therefore, under the present facts, if applicants can show that the claimed length-to-diameter ratio is critical, the recited feature cannot be dismissed as merely "discovering the optimum or working ranges." Applicants explain the criticality of the claimed length-to-diameter ratio as follows:

When the length-to-diameter ratio of the beam-emitting holes is 2 or greater, ion particles can convert to neutral particles. (See applicants' specification, *e.g.*, from page 13, line 15, to page 14, line 5.) That is, with the claimed length-to-diameter ratio, the beams source produces a result that is different in kind and not merely in degree. Therefore, the claimed length-to-diameter ratio cannot be dismissed without a teaching or suggestion of it in the prior art.

The rejection relies on the Ahonen accelerator grid 262 to teach the claimed beam-emitting electrode. In column 5, lines 31-44, discussing the diameters of the holes, there is no description as to the length-to-diameter ratio. Applicants find no discussion of a length-to-

diameter ratio for neutralizing an accelerated ion beam. Therefore, a rejection cannot rely on the Ahonen accelerator grid 262 to teach a beam-emitting electrode as described in the claims.

It seems that the Examiner might agree, because the Office Action states on page 5 that Ahonen and Hashimoto et al. fail to teach the dimensions recite in claim 16. (Canceled claim 16 had recited the claimed length-to-diameter ratio.) Although the Office Action continues with broad citations to England et al. for multiple claim features, the Office Action provides no discussion of how England et al. could supposedly teach or suggest the claimed length-to-diameter ratio.

Accordingly, no proper justification was ever provided for rendering the claimed length-to-diameter ratio unpatentable based on Ahonen, Hashimoto et al. , and England et al., so the rejection of claims 1, 12, and 14 should be withdrawn.

Claim 4, now canceled, also had recited the claimed length-to-diameter ratio, and the rejection of claim 4 relied on Ahonen, Hashimoto et al., and England et al. with the addition of Savas (U.S. Patent No. 5,983,828) and Kinoshita et al. (U.S. Patent No. 5,518,572). The Examiner explains his rationale for the rejection on pages 6 and 7 of the Office Action. This explanation elaborates upon the Ahonen and Kinoshita et al. disclosures. Regarding Ahonen, applicants explain above why this reference does not teach or suggest the claimed length-to-diameter ratio.

Regarding Kinoshita et al., the Office Action cites microchannel plate 34 and characterizes the plate as able to "produce neutral particles by charge exchange." However, microchannel plate 34 is not a beam-emitting electrode as claimed. Instead, it is a porous plate made of insulating material, such as shower nozzle type thin quartz comprising hollow glass fibers. (Column 11, lines 14-19). The text in column 12, lines 12-22, indicates that the

microchannel holes 34A are provided for aligning particles that were already neutral before reaching the microchannel holes.

Therefore, applicants must respectfully disagree with the statement in the Office Action, "Kinoshita (572) discloses the use of a microchannel plate to produce neutral particles by charge exchange ..." Kinoshita et al. never discloses the use of a microchannel plate to produce neutral particles by charge exchange.

Therefore, none of the asserted references disclose or suggest a neutral particle beam source as described in claim 12, such that "charge exchange takes place in said beam emitting holes formed in the downstream electrode, resulting in an emission of a neutral particle beam."

Applicants acknowledge that Kinoshita et al. also discloses an embodiment of microchannel plate 34 with a surface electrode 34B (column 16, lines 10-11) and another embodiment with surface electrode 34B and a second surface electrode 34C (column 16, lines 29-30). However, applicants find no teaching that either first surface electrode 34B or second surface electrode 34C has a length-to-diameter ratio of 2 or greater as claimed.

Because Kinoshita et al. does not teach a beam-emitting electrode on the downstream end having the claimed length-to-diameter ratio, a rejection based on Kinoshita et al. having such a teaching cannot be proper and should be withdrawn.

In view of the remarks above, applicant solicit the withdrawal of the rejection of claims 1, 12, and 14 for at least the reason that the claimed length-to-diameter ratio is not merely a discovery of an "optimum or working range" and that the asserted prior art does not teach or suggest the claimed length-to-diameter ratio, which enables ion particles to convert to neutral particles.

As a second and independent reason to withdraw the rejection of claims 1, 12, and 14, applicants refer now to the following features recited in independent claims 1 and 12 *in combination with* the claimed length-to-diameter ratio:

> ... said mesh electrode comprises a cross mesh having a wire thickness and width of 0.1-0.5 millimeters and has an open area ratio of 85% or less and an aspect ratio of open areas provided in said mesh electrode is less than 1;
>
> wherein accelerating voltage of 1 kV or less is applied between the mesh electrode and the downstream electrode and the two electrodes on the downstream end are separated by a distance of 10-30 millimeters ...

Claim 14 depends from claim 12, so claim 14 also describes a beam source with these features. Although the previous position of the PTO may have been that a beam source with this combination of features is merely an optimization of values, applicants explain as follows why such beam source is both new and non-obvious:

As applicants discuss in their specification (see, *e.g.*, page 11, line 18, to page 12, line 15), even though high density plasma, which has a short sheath length, is formed in the plasma chamber, a mesh electrode as described in the claims with the other recited elements can efficiently generate a high-density energy beam having good directivity and a relatively large beam diameter. The reason is due to the precise configurations of the cross mesh, the distance between two of the electrodes recited in the claims, and the beam emitting holes in the downstream electrode. Applicants discuss the beam emitting holes in depth above. Regarding the cross mesh and the distance between electrodes, applicants elaborate as follows:

First, regarding the cross mesh, when high-electron-density plasma is used for generating a high-density energy beam, the sheath length of the plasma decreases (see Fig. 3). However, the hole diameter of the mesh electrode must be smaller than the sheath length of plasma to generate an energy beam from the plasma through the mesh electrode. High density plasma having

electron densities of 10^{11}-10^{12}/cm^3 can easily be obtained by using high frequency (RF) discharge or the like, and then the sheath length becomes 0.1-3 mm. In the present invention, because the mesh electrode comprises a cross mesh (see Fig. 4B) with a wire thickness and width of 0.1-0.5 mm and an open area ratio of no more than 85%, a high density electron beam can be generated in the mesh electrode having a smaller diameter (length of open area) than the sheath length of the plasma.

Furthermore, the sheath length of plasma varies according to the applied voltage (acceleration voltage) between the mesh electrode and the downstream electrode. (See again Fig. 3.) Recently, low acceleration-voltage energy beams (less than 1 kV) have become necessary, for example, in micro-fabricating processes such as deposition or etching. Such acceleration voltage causes the plasma sheath length to decrease. Thus, to generate a high-density energy beam using a low acceleration voltage, the open space in the mesh electrode must decrease, the number of open spaces must increase, and the distribution of open spaces must be made wider. Such reconfiguration is possible with the claimed invention.

Regarding the claimed distance between the two downstream electrodes, as applicants explain in the specification (see, *e.g.*, page 12, line 28, to page 13, line 14, and Fig. 6), when an accelerating voltage of 1 kV or less is applied between the two electrodes, if they are separated by a distance of 10-30 mm, a relatively low energy beam (less than 1 kV) appropriate for micro-fabrication can be obtained. Such a beam provides better processing speed and is therefore desirable for micro-fabricating processes such as deposition or etching as discussed above.

Therefore, although individual values recited in the claims were previously considered merely optimizations, the combination of all features as recited should be considered both new and non-obvious. Even if the first discussion above, regarding the claimed length-to-diameter

ratio of the beam-emitting holes in the downstream electrode, is not persuasive on its own for withdrawal of the obviousness rejection, applicants solicit the withdrawal also for the reason that the claims recite a combination of features that provide a non-obvious beam source performing as described above.

Claims 5, 11, and 22 are also rejected as obvious. Each of these claims depends from one of claims 1 and 12, and, as discussed above, the rejection of those claims should be withdrawn. Therefore, the rejection of claims 5, 11, and 22 should be withdrawn for at least the reason of their dependency. Applicants acknowledge that the claims 5, 11, and 22 are rejected based also on additional prior art, but the rejection of those claims is based on the validity of the rejection of the parent claims.

In view of the remarks above, applicants now submit that the application is in condition for allowance. Accordingly, a Notice of Allowability is hereby requested. If for any reason it is believed that this application is not now in condition for allowance, the Examiner is invited to contact applicants' undersigned attorney at the telephone number indicated below to arrange for disposition of this case.

In the event that this paper is not timely filed, applicants petition for an appropriate extension of time. The fees for such an extension, or any other fees which may be due, may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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Enclosure: Petition for Extension of Time for Response

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